Contents

Summary

Another type of data supported by IOOS DIF is "coverage, i.e. object covering a geographical area. Coverages are represented by arrays of gridded numerical data values, and can be just a set of data points or a regular grid of points; a set of segmented curves (e.g. road paths) or a set of polygons.

Data Encoding

Coverage data can be presented in a number of well-known formats, e.g., netCDF, HDF, floating-point TIFF. However, in order to reach compatibility with the DIF specifications, the data should be encoded in netCDF format in accord with the Climate and Forecast (CF) Conventions.

NetCDF (network Common Data Form) is a machine-independent format for representing scientific data developed at Unidata Program Center. Unlike many other data formats, netCDF includes a set of software libraries and other applications that support the creation, access, and sharing of data. NetCDF software and documentation are free, and can be downloaded from the Unidata Web portal. A tutorial on writing netCDF files and sample files are also available.

The CF conventions define metadata that provide a description of what the data in each variable represents, and the spatial and temporal properties of the data. This enables users of data from different sources to decide which quantities are comparable, and facilitates building users' applications.

The online checkers are available to ensure the netCDF data file compliance with the CF conventions.

Data Sharing

For sharing coverages IOOS DIF recommends an adaptation of OGC Web Coverage Service (WCS) or service based on the Open-source Project for a Network Data Access Protocol (OPeNDAP).

Both services allow data to be accessed regardless of its underlying data format; support subset retrieval of geospatial data; however, WCS and OPeNDAP specify data sub-setting and sub-sampling in different ways (OPeNDAP operates in index space rather than coordinate space) .

OPeNDAP

OPeNDAP is an open-sourced and widely supported protocol for requesting and transporting data across the Web. The protocol allows data to be accessed regardless of its underlying data format. OPeNDAP allows sub-setting and sub-sampling data sets based on variable name, spatial range, and temporal range.

There are a number of OPeNDAP servers. The Unidata THREDDS Data Server has aggregation capabilities and allows for the creation of virtual NetCDF Datasets via NcML.

There are also a number of OPeNDAP client APIs and end-user applications. The API libraries for interfacing with the OPeNDAP service. The client software helps to convert common scientific tools (such as Matlab, IDL, Ferret, GrADS) into applications able to access remotely served data. The API supports a number of commonly used programming languages such as C++, Java and Python for custom application development.

OPeNDAP has been commonly used throughout NOAA for serving of oceanographic, meteorological and climate data. IOOS DIF recommends using OPeNDAP technologies over the OGC Web services due to the inability of WCS 1.1 to handle anything other than regularly spaced gridded data and the widespread availability of OPeNDAP servers and clients.

Web Coverage Service (WCS)

WCS functions

The WCS interface generally specifies three functions that may be requested by a WCS client and performed by a WCS server [2]:

- ***GetCapabilities*** function allows a client to retrieve information about service capabilities in a form of XML document.
- ***DescribeCoverage*** function retrieves metadata about a specified dataset, i.e. descriptions of one or more coverages served by a WCS server in a form of XML document that fully describes the coverages.
- ***GetCoverage*** function allows a client to request coverage comprised of selected range properties at a selected set of geographic locations; server extracts the response data from the selected coverage, and encodes it in a proper format.

WCS implementations

- Prototype IOOS WCS has been set up by NDBC using Unidata THREDDS server, and is used to share the HF Radar data within limited community in test mode.

Sample WCS function requests

NDBC Prototype WCS server replies with the real HF Radar data samples to the following function requests for the US East Coast and Gulf of Mexico 1km resolution data:

- ***GetCapabilities***
- ***DescribeCoverage*** for **u** and **v** vector components
- ***GetCoverage*** :
    - for **u** vector components at 2009-02-26T00:00:00Z bounded by 98W 21N and 57W 47N in NetCDF3 format

- for **u** vector components at 2009-02-26T00:00:00Z bounded by 98W 21N and 57W 47N in GeoTIFF format

More sample requests are available on NDBC Prototype WCS site.

Cookbooks, tutorials, implementation guides

TBD

System requirements for WCS implementation

- Web server capable of running CGI or PHP scripts
- Coverage database in any format
- Scripts and software libraries to provide WCS interface to the database back-end

Unidata Thematic Realtime Environmental Distributed Data Services (THREDDS) server can also be used to serve WCS data. The THREDDS WCS server can return data in GeoTIFF24 as well as in netCDF formats.